

BRINGING VISIBILITY TO THE ORIGINAL SPLENDOUR OF A LOST WONDER OF THE ANCIENT WORLD: THE TEMPLE OF ARTEMIS AT EPHEBUS

Ahmet Denker^{1,2}

¹ Faculty of Engineering and Natural Sciences, Istanbul Bilgi University, Istanbul, Turkey
ahmet.denker@bilgi.edu.tr

² College of Engineering, University of South Florida, Tampa, USA
adenker@usf.edu

KEY WORDS: Temple of Artemis at Ephesus, Seven Wonders of the Ancient World, Virtual Reconstruction.

ABSTRACT:

The visualization work presented here seeks an answer to one of the most persistent problems of our cultural heritage: to make visible the original splendour of the lost Temple of Artemis, one of the seven wonders of the world whose glory could not be surpassed in the Classical Age by any other building. Unfortunately, neither the discovery of the temple, which was found after many years of searching, nor the excavations carried out in the following 150 years were enough to completely remove the veil of mystery from this enigmatic temple, and a completely factual and academically accepted reconstruction has not been possible until today. In this article, it has been tried to give an answer to how this world-wonder temple looked. The goal is to recreate the Temple of Artemis in virtual space using tools and methods at the forefront of digital technology. The effort to bring visibility to the temple provides an opportunity to keep this unique work of our cultural heritage alive in our memories and to increase its accessibility and awareness by providing digital access to the structure that is no longer physically accessible. The most attractive and distinctive feature of virtual reality is that it can take the observer out of the spectator position and into the virtual environment. Images of the reconstruction of the Temple of Artemis are presented in the results section of the article.

1. INTRODUCTION

The Temple of Artemis at Ephesus (Figure 1) had such a great reputation in ancient times that it was counted among the seven wonders of the world. Much has been written, said, and drawn about it. Perhaps no other temple in the world puzzled scholars like the Artemision of Ephesus with its mystery, obscurity and inaccessibility. The Artemision of Ephesus was the symbol of Ephesus, and although it was destroyed 7 times, it was rebuilt each time as bigger and more magnificent by the Ephesians. The subject of this article is the temple, which Antipatros of Sidon and Philo of Byzantium described as one of the 7 wonders of the world. This is the eighth and last temple, built in 4th century BC and known as the Classical Artemision because it belongs to the Late Classical period. Its destruction continued after its annihilation by the Goths in 263, its ruin was systematically looted and eventually lost, buried under about six meters of alluvial mud. Until its rediscovery, the temple, one of the seven wonders of the world, was known only through a few short paragraphs of ancient writers. On the last day of 1869, lost for centuries and long sought; the temple, whose existence was doubted about, was finally found by the Englishman John T. Wood (Wood, 1877).

Some questions were answered by Wood's discovery of the temple, but many remained unanswered. "How can we envision this building, which is the wonder of the classical world?" is the question waiting for an answer. This question has preoccupied many archaeologists, architects, and artists since the early years of the Renaissance, when the Classical Age began to be rediscovered. The reconstructions made until the temple was found in the 19th century were figments of imagination, far from being a restitution of ancient reality. Unfortunately, neither the discovery of the temple nor the excavations carried out in the following 150 years have been enough to completely break the veil of mystery on this enigmatic temple, and a completely

factual and academically accepted reconstitution has not been possible until today. In this article, an attempt has been made to reconstruct the Temple of Artemis and to give a picture of what this world-wonder temple looked like. The goal is to recreate the Temple of Artemis in virtual space, using the tools and means at the forefront of digital technology. In doing so, the goal is not just to recreate the temple in any virtual way, but to infuse it with meaning. This goal has infiltrated all workflow levels in the virtual rebuilding of the temple. Since the temple was destroyed not by nature, but by man, and because it was plundered for years as if it were a marble quarry, almost all of the museum pieces, except for a few, are fragmentary.

Based on these pieces, a new reconstruction of the temple was made by developing a 3-dimensional model that revives the real appearance of the temple, thus trying to answer the question of how Artemision actually looked. Regrettably, since the Temple of Artemis at Ephesus was completely destroyed, we no longer have the opportunity to experience it in the real world. However, we have the opportunity to experience it in the virtual world.



Figure 1. Geographical location of the Temple of Artemis.



Figure 2. The sacred site of the Temple of Artemis today
(Photos by the author)

Although the mindset of the architects of the Temple has been lost to us forever, it has been possible for us to resurrected virtually through digital reconstruction, as the architects of this world wonder may have designed it hundreds of years ago. This discourse has been brought to actuality as the increasingly capable hardware and software resources are pushed to the extreme limits of their capabilities in the quest to create a complete representation of the past reality of this temple. The most attractive and distinctive feature of virtual reality is its ability to pull the observer out of the spectator position and into the virtual environment. Images of the reconstruction of the Temple of Artemis are presented in the results section of the article.

2. THE LURE AND CHALLENGE OF THE VISUALIZATION OF THE TEMPLE OF ARTEMIS

The ability to create 3D reconstructions of ancient architecture in fidelity to the original obviously depends on the extent to which the real building has survived to the present day. 3D reconstruction initiatives are both more attractive and more challenging when it comes to cultural heritage sites and monuments where almost nothing from the past is left behind. The Temple of Artemis in Ephesus was the one of the most mysterious and magnificent of those lost edifices which fall in this category.

Ephesus and the Temple of Artemis, were excavated in the 19th century at a time when modern archaeological excavation methods were not yet developed. During these excavations, the surviving archaeological critical data about the temple were largely destroyed or lost. Now, we can only guess what the temple looked like. Since the data from archaeological remains are insufficient for a complete virtual reconstruction, the realism of the virtual reconstruction largely depends on the many inferences made during the modelling phase. The virtual reconstruction here ultimately includes findings from the

underlying archaeology and inference steps to rebuild the temple that no longer exists.

In such situations, where archaeological evidence is insufficient, it is an inevitable impulse of human intelligence to draw inferences from the collected evidence, make assumptions, interpretations, and even speculate. Recreating scenes from the past should neither be devalued through reconstructions nor excluded from the process. Because today's audience both accept the reconstruction of the past and expect to be able to feel and experience the past. The need to graphically create a mimetic reconstruction of the superstructure that no longer exists is an important incentive for the fill-in-the-blanks initiative. Some parts of the superstructure rely directly on archaeological data, while others rely on literature sources, numismatic evidence, and details gathered from other similar Ionian temples. Virtual reality methods allow us to collate large amounts of data and synthesize and visualize them as a virtual recreation of the architectural design of the temple.

3. ARCHAEOLOGICAL FINDINGS REGARDING THE ARCHITECTURE OF THE TEMPLE

3.1 Artemis' Last Abode: The British Museum

The reconstruction of the temple cannot be possible without a visit to the British Museum. Almost all of the significant ancient artifacts belonging to the Temple of Artemis are in the warehouses of the British Museum. At the time of reconstructing the temple, these warehouses were studied with the special permission of the British Museum, and the reconstruction of the temple was largely based on these studies. Two separate photographs by the author, showing the pieces in the collection of the museum are presented in Figures 3 and 4.

Today, the relief column piece in Figure 3 is among the most precious pieces of the British Museum. This sculptured column drum, which has survived relatively intact appears to have been made by a single sculptor, it probably depicts the Alkestis myth. This piece is among the finest examples of Greek sculpture. The scales of the figures are on the scale of nature and were probably most visible at the forefront of the portico.

In addition to the aesthetics of the found fragments, their sizes also give information about the grandeur of the temple and reveal how much of a cultural treasure we are deprived of by losing this temple.



Figure 3. The column drum still on display in one of the main halls of the British Museum (Photo by the author)

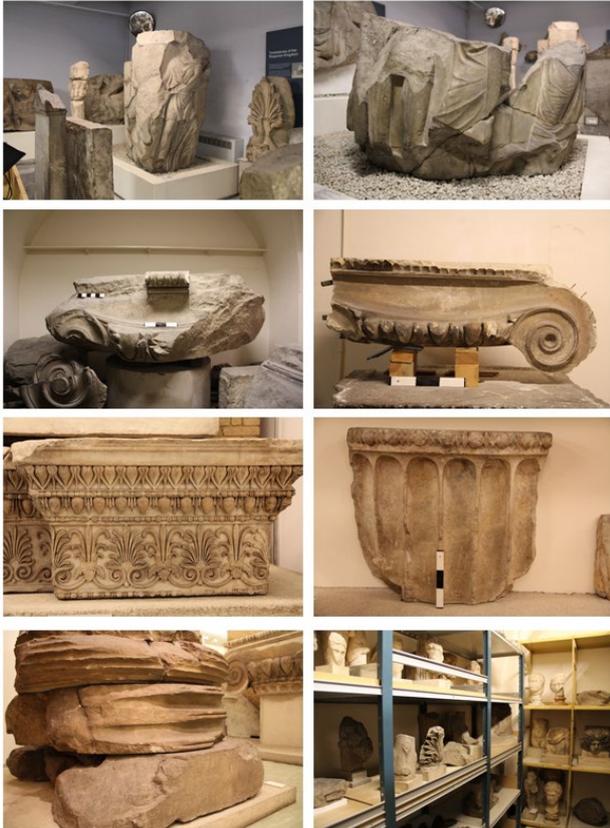


Figure 4. Relief drums, ionic capitals, frieze fragments found in the warehouses of the British Museum. (Photo by the author)

3.2 Columns

With the Archaic Artemision (the 6th century B.C. building preceding the Classical Artemision), the Ionic order, which was accepted as a more elegant order than the Doric order before it, distinguished itself with the relative increase in column heights and the slenderness of the shaft of the column. The height of the column in the Classical Temple is 18 meters or 9,6 times the diameters of shafts. This is the height that Pliny also said. Shafts have 24 flutes; a rare piece in the British Museum is seen in Figure 5.



Figure 5. A rare column fragment from the Archaic Temple in the British Museum (Photo by the author)

3.3 Column Bases

In Figure 6, it is seen that the bases of the columns of the Temple of Artemis are very meticulous.

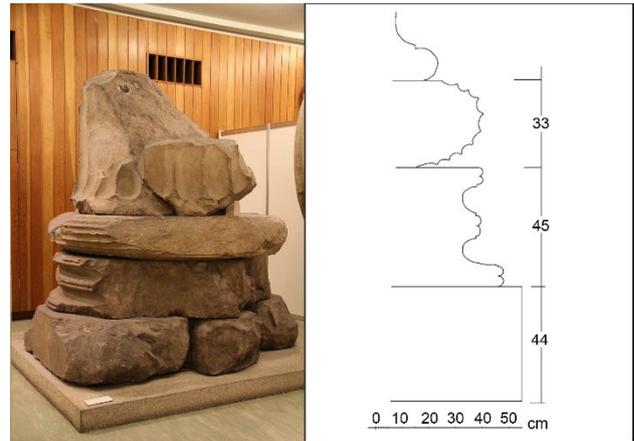


Figure 6. A rare column base from the Archaic Temple in the British Museum and its drawing (by the author).

In the column base of the temple of Artemis, three tori decorated with two convex rings were separated by two concave scotia.

3.3.1 Sculptured Column Bases: During his excavations Wood found fragments of sculptured columns (*columnae caelatae*) as mentioned by Pliny. Relief fragments unearthed during the Artemision excavations at Ephesus are now in the British Museum, some of which are shown in Figure 7. Some of them are drums while others are cubic pedestals. *Columnae caelatae* were not found in situ, and once discovered they led to a problem that archaeologists had been trying to solve for a long time. For Pliny, who spoke of the sculptured drums, did not say anything about the cubic bases, the arrangement of pedestals and drums has been a subject of much debate for over 100 years. Restoration proposals on how they should be positioned have been put forward by several authorities (Murray, 1889). Allied to this, Sculptured drum-cubic pedestal restorations exhibited in The British Museum have changed over time (Figure 8)



Figure 7. Some fragments of the famous *columnae caelatae* of the Temple of Artemis at the British Museum (Photos by the author)



Figure 8. Sculptured drum-cubic pedestal restorations exhibited in The British Museum have changed over time (Sources: The British Museum archive and the photo by the author)



Figure 9. Two capitals from the Archaic temple in the British Museum (Photo by the author).

3.3.2 Ionic Capitals: There is a remarkable expression of grace and energy in the capitals of both Archaic and Classical temples. From three rare examples (Figures 9 and 10) in the British Museum, we can imagine how impressive the perspective effect a series of these would create when put together. We can safely say that the first stretch capitals were made to reduce very large openings. The great capitals of the Temple of Artemis coincide with the problem caused by the great architraves described by Vitruvius and Plinius. Their accounts were probably based on the lost book of Chersiphron and Metagenes, the architects of the Archaic temple. Although the Ionian capitals of the 6th and 4th century temples differ in detail, they share two main elements: egg and arrow decoration and decorative aspects. Reducing the number of eggs in the younger temple made them larger and more visible.



Figure 10. A rare capital from the 4th century temple in the British Museum (Photo by the author).

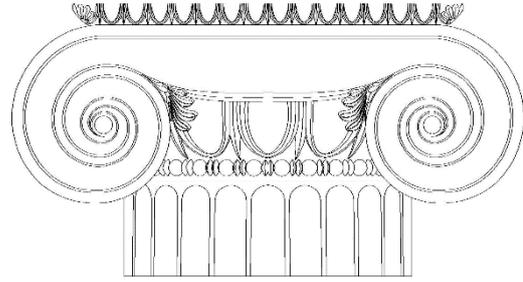


Figure 11. Drawing of the capital from the 4th century temple in the British Museum (Drawing by the author).

These designs of the capitals of the Temple of Artemis have survived for 10s of centuries and have been the most defining symbols of the Ionic order.

3.3.3 Tympanum. Only two blocks of the tympanum were found. One of these blocks brought to The British Museum belonged to the Archaic Temple (6th century) and the other to the Younger Temple (4th century). At the British Museum, A.H. Smith also confirmed that they belonged to the tympanum (Figure 12). These two pieces were featured in Smith's book *A Catalog of Sculptures in the Department of Greek and Roman Antiquities* (Smith, 2015) with inventory numbers 1232. 1. 2.



Figure 12. Two fragments of the tympanum of the Archaic and Classical Temples (British Museum photo archive)

Photographs from the archives of the British Museum can be seen in Figure 12.

3.4 Material, Colour and Workmanship

The Archaic Artemision was a building where firsts were practiced in many ways. The first use of marble in the construction of temples in the Aegean is one of them. Ephesus Artemision was an interurban project where stonemasons from different parts of Asia Minor shared their techniques, demonstrated their skills and developed new methods. The massive mass of the temple, which required an estimated 50,000 cubic meters of marble volume, suggests that finding enough homogeneous marble from a single source certainly must have been a problem. Such a huge architectural mass could only be built with local marbles. How the source of the marble used in the Temple of Artemis was found is described by Vitruvius (Vitruvius 10, 2.15). Colour was integral to the ancient experience of the temple, which was surrounded by a forest of columns. The possible purpose of the colouring may be to make the building more visible from afar. Vitruvius said that at first glance, the local marble used for the Ephesus Artemision was 'extremely white'. In this temple, due to the stone shine of the newly mined marble, it seems preferable to highlight the craftsmanship with colour effects.



Figure 13. The shimmering of the marble surface of some of the temple fragments reveals areas of colour with the last traces of different brightness tones (British Museum) (Photo by the author)

Since the temple achieves its true and intended effect through colouring, reconstruction work without attention to them is a serious loss of understanding of the temple and unfair to the importance of aesthetic values of its architects. Contrary to the Renaissance, it was not possible to accept clear white marble as it is, neither in the Archaic nor in the Classical period. Colouring has been seen as a method of increasing the expressive power of the marble of a work of art or architectural work. The pure form obtained from pure marble was considered only a first step towards the completion of the work. The artist achieved the vitality he wanted only with the application of colour. The shimmering of the marble surface of some pieces reveals areas of colour with the last traces of different brightness tones (Figure 13). Only three-color remnants were found, these were Egyptian blue, vermilion red, and ochre yellow.

4. ARCHITECTURE NUMISMATICA

In his book *Architectura Numismatica*, Thomas L. Davidson (Davidson, 1959) presented the first known numismatic evidence of what the temple looked like. This was a medal minted by Emperor Mark Antony Gordianus (c. 159 -238). He showed that the temple was octastyle as described by Vitruvius, and that Pliny was right about the sculptured columns, *columnae caelatae* were shown with unequivocal clarity! (Figure. 14).



Figure 14. A medallion showing the façade of the Temple of Artemis, minted by Emperor Mark Antony Gordianus (c. 159 -238).

As stated by Price and Trelle (Price and Trelle, 1977), coins and medallions are reliable source materials for the reconstruction of lost monuments. The coins in question were Roman coins.

Architectural themes on coins were very rare in the Greek world. Roman coins have been valued and studied in this work

for the evidence they provide for the reconstruction of the Classical Artemision. With the discovery of a number of other Roman coins, the octastyle features of the Ephesus Artemision façade are well established. Artemis appears between the columns. It is noteworthy that the features of the cult statue of the goddess were described with remarkable accuracy.



Figure 15. Two Roman coins showing that the façade of the Artemision of Ephesus was octastyle A) Antonius Pius (138-161) B) Valerian (253-260). (Source: British Museum Numismatics Section).

Compared to written sources and architectural evidence, it is clear that engravers remained true to the original architecture (within the limits of abbreviation), never inventing details. In all coin samples, the Ionic order in the temple is faithfully represented, never using the wrong type of capitals.

These coins are still very important for the reconstruction of the façade of the temple, for they are the only evidence, apart from the well-known description of Pliny, which is the only written source for the appearance of the famous temple. The coins provide the final answer to questions about the design of the pediment. Since only two parts of the temple's tympanum are preserved (See 3.3.3), this part of the building has long been covered by a veil of obscurity. Ancient coins provide the evidence needed for reconstruction. Three rectangular shapes stand out on the pediment of the temple on large Ephesus coins. The Maximus coin in Figure 16 has a unique importance among many coins of Ephesus, its uniqueness is that it clearly shows the famous *columnae caelatae* (sculptured columns) mentioned by Pliny. This coin seems to give the final and definitive answer to the question of how to locate the *columnae caelatae*. We know that the Classical Temple was on a higher podium compared to the Archaic Temple. It was surrounded by a multi-step crepidoma. Numismatic proof of this is shown on the Maximus coin.



Figure 16. Stuart Shaw's reconstruction of the Temple of Artemis after the Maximus Coin is on display at the British Museum.

On this coin, the high podium is indicated by seven steps. Although this number is not the actual number of steps, it is higher than the number of steps shown on most coins. In doing

so, the carver confirmed the high podium that Philo of Byzantium spoke of. The crepidoma had ten steps, according to him.

5. VIRTUAL RECONSTRUCTION OF THE TEMPLE

5.1 Workflow of the Virtual Reconstruction

The Temple of Artemis has been studied through the evidence provided by various groups (historians, archaeologists, architectural historians, epigraphists, numismatists). Because the evidence provided by these separate groups is so fragmentary, the successful reconstruction of the temple necessitates the synthesis of these fragmented bits of information. We started with literary evidence and historical studies and reviewed the archaeological, epigraphic and numismatic evidence.

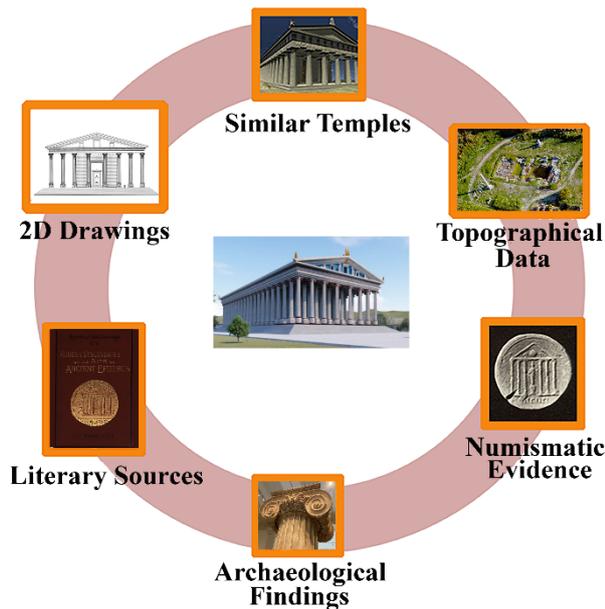


Figure 17. Workflow of the reconstruction process of the temple.

When synthesized with a comprehensive approach in a larger context, the synthesized data allows us to reconstruct the temple and temenos in the 4th century with reasonable accuracy.

5.2 Phases of the Virtual Reconstruction

The architectural features of the temple are presented in Table 1.

Peristyle Type	Portico Style	Stylobate Length	Stylobate Width	Crepidoma Number of Steps	Columns Line-up	Column Lower Diameter	Column Height
Dipteral	Octastyle	118.48 m	51.44 m	10	8x21	1.978 m	18.52 m

Table 1. Measurements and values used for the reconstruction of the temple

Consequently, the temple could be reconstructed as a dipteral Ionic building on a ten-stepped crepidoma with 8 columns in the front (west) and 9 in the rear (east) and 21 on the sides. Digital tools provide a facility to align the architectural and quantitative information summarized in Table 1 with textual, textual and geographic information. The digital reconstruction of an ancient temple and its temenos has several stages. These include 2D drawings of ancient monument in comparative dimensions. Converting from 2D drawings to 3D objects, placing them in relative positions and directions on the geospatial plan

representing the topography and natural landscape; creating 3D graphic elements with surfaces consisting of a series of polygons. These surfaces are given a photorealistic appearance by using appropriate texture maps and lighting. The placement of light sources that create the lighting and shadow effects of the Aegean sun is important to create the right atmosphere. (Figure 20).

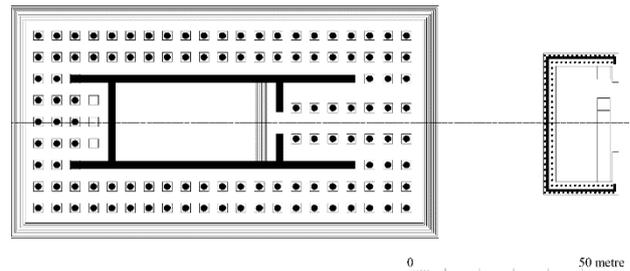


Figure 18. After Anton Bammer's reconstruction plan (Bammer 1972), which also shows the Altar.

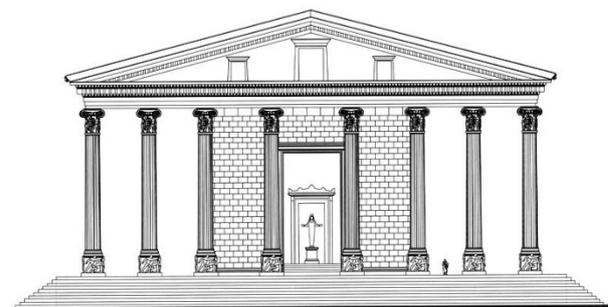


Figure 19. Reconstruction drawing of the façade of the Young Artemision

The stages of 3D modelling of the temple are presented in Figure 20.

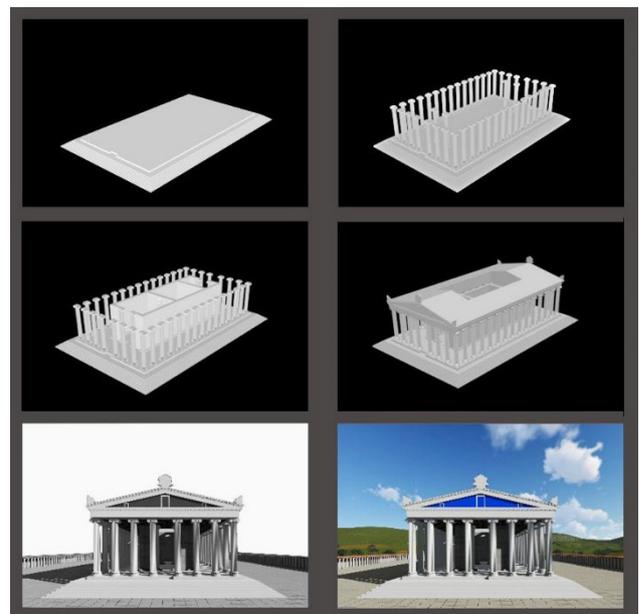


Figure 20. Stages of 3D modelling of the temple

6. RESULTS

The stylistic and structural features of the Temple of Artemis, which are difficult to detect from 2D drawings and other sources, and its spatial relationship with the landscape can be presented much better in 3D models. First, a bird's-eye view of the Temple building and its temenos are presented in Figure 21.



Figure 21. Bird's-eye view of the temple and its sanctuary

Near the middle of a wide temenos is seen the temple building which extends in an east-west direction, with a small inclination towards the north. The temenos is closed by four porticos and the elevations of Ayasuluk can be seen on the east side. The propylon and the altar are on the west side. In Figures 22 and 23, the aim is to portray how visitors approaching the temple see the magnificence of the building.



Figure 22. First view of the temple through the eyes of a visitor entering the temenos from the propylon.



Figure 23. First view of the temple through the eyes of a visitor entering the temenos from the propylon.

The most distinctive feature that distinguishes the Ionic temples in the east of the Aegean from the Doric temples on the west coast was the elongated and fluted columns. This feature, which is established with the Temple of Artemis is the dominant element of the facade view. It is portrayed in Figure 24.



Figure 24. First view of the temple through the eyes of a visitor entering the temenos from the Propylon.

As the uppermost member of these columns, spirally curved volute capitals occupied the most visible position of the temple (Figure 25).



Figure 25. As the topmost member of an Ionic column, the volute capital occupied the most visible position of the temple.

One of the most unique architectural features of the Temple of Artemis is the relief column drums (*columnae caelatae*) shown in Figure 26.



Figure 26. One of the most unique architectural features of the Temple of Artemis was the relief column drums (*columnae caelatae*)



Figure 27. One of the most unique architectural features of the Temple of Artemis was the relief column drums (*columnae caelatae*)

As in other temples of this size (the Temple of Apollo in Didyma, the Temple of Artemis in Sardis, etc.), the roof of the temple was open (Figure 27). Such temples were classified by Vitruvius as hypaethral temples.

7. CONCLUSIONS

Visualization of the Temple of Artemis provides a clear picture of the Ionian architecture on the Eastern shores of the Aegean during the Archaic and Classical periods. Designed by pioneering and leading architects, whose names we learned thanks to Vitruvius, this temple, with its sparkling white marble structure and one-of-a-kind sculptured columns, offered a 'magnificent' visual feast to its visitors for years as the most important Ionian style building in the region. This splendor was the result of an architecture that stemmed from the cultural and aesthetic values that settled in this particular geographical area over a long history. The temple was built eight times, each time more magnificent than the previous one, and all eight of them were destroyed. The last two temples took several centuries to build and their paths crossed with legendary names such as Lydian King Croesus and Alexander the Great. Reconstructed here is neither the building that Croesus gifted his relief columns nor the building that was burned on the day Alexander the Great was born, it is the temple that was under construction when Alexander the Great visited Ephesus.

This monument of Ionian architecture, with its symbolic signs, columns, spirally curved capitals and ornaments, reflects both the influences of philosopher-mathematicians who influenced Ionian society in general, and the visions of architects who were sensitive to them. After all, the Temple of Artemis was not built and used in a vacuum. The temple would exist long after the people who produced it died, but it didn't. This temple will never stand up again. Not a single pillar remained standing in its sanctuary. The cult statue of the Goddess Artemis, the patron goddess of Ephesus, has survived to the present day by a miracle.

The legendary lost architecture of the Temple of Artemis is recreated in this paper with its 3D virtual structure. Virtually resurrecting the Temple of Artemis can be likened to fulfilling the will of an age, to claiming the legacy we have inherited from the people who lived in that age. In terms of conveying information, the target audience of this reconstruction is archaeologists, those who are well-educated in a field other than archeology, as well as illiterate people, and those who saw the ruin of the temple and heard about its fame and wondered about its original state.

The results presented show the reconstruction of a largely documented temple. The plan and façade drawings distilled from the archaeologists' years of excavation and research, the dimensions and column heights calculated from the descriptions of Pliny and Vitruvius, the remains in the British Museum, the Roman coins depicting the building's façade, provided enough information to create a reliable virtual replica of the temple presented in this work. However, it was inevitable that this reconstruction would be supported by some hypothetical elements.

The theme of creating a digital replica of the lost temple of the goddess of Ephesus has the potential to have very resonant consequences. Creating, viewing, manipulating, archiving and sharing a digital representation of the shape and appearance of this temple required solving the most challenging problems of virtual reality applications. Along with the immersive visualizations offered by digital technologies, a virtual 3D visit to the sanctuary of the Temple of Artemis provides a very attractive opportunity to peruse this temple or experience its cultural space. As the 3D reconstruction model of the temple can be edited in terms of both shape and appearance and functional properties, it provides a wealth of information that can be analyzed, tested and improved. This 3D reconstruction, which provides digital access to the temple, which is no longer physically accessible, offers an opportunity to preserve this unique work of our cultural heritage in our minds, to increase its accessibility and awareness.

ACKNOWLEDGEMENTS

The reconstruction of the Temple of Artemis was only possible as a result of the author's work in the British Museum, which contains almost all the important pieces of the temple discovered so far. The writing of the paper you are beholding therefore owes a great deal to the members of the British Museum's Greek and Roman Antiquities Department. The author would especially like to commemorate the name of Sir Ian Jenkins, who we lost two years ago.

REFERENCES

- Bammer, A.1972. Die Architektur des Jüngerer Artemision von Ephesos, Franz Steiner Verlag Wiesbaden GmbH.
- Murray, A.S. 1889. "Remains of Archaic Temple of Artemis at Ephesus." *The Journal of Hellenic Studies*, Vol.10.
- Pliny, 1968. *Natural History*. Edited and translated by H. Rackham. Cambridge, MA: Harvard University Press.
- Price, M.J. and Trel, B. L. 1977. *Coins and their cities: architecture on the coins of Greece, Rome and Palestine*. London: Vecchi.
- Smith, A.H., 2015. *A Catalogue of Sculpture in The Department of Greek and Roman Antiquities, British Museum, Volume 2*, Palala Press.
- Vitruvius 2001. *Ten Books on Architecture*. Rowland, I.D.(Editor), T.H. Howe (Editor), Cambridge University Press.
- Wood, J.T.1877, *Discoveries at Ephesus*, reprinted by Andesite Press (August 8, 2015)